

Listing of the Claims:

The following is a complete listing of all the claims in the application, with an indication of the status of each:

1 Claim 1 (Currently Amended). A computer implemented encoding and
2 correcting method comprising the step of performing only exclusive OR
3 operations on words for error correcting codes with four or more check
4 symbols which can correct as many errors ~~are~~ as there are check symbols.

Claim 2 (Canceled).

1 Claim 3 (Currently Amended). ~~The~~ A computer implemented method for
2 encoding data and correcting erasure errors ~~recited in claim 2~~ comprising
3 the steps of:
4 converting a code over a finite field of characteristic two which can
5 correct up to e erasure errors into a code which can correct up to e erasure
6 errors in words;
7 encoding data using the converted code;
8 reading the encoded data and correcting up to e erasure errors in
9 words, wherein the converted code is a (3, 3) code, wherein even if all the
10 information in any three of the words w_i is erased, the data can be
11 recovered.

1 Claim 4. (Original)A computer implemented encoding and correcting
2 method comprising the steps of:
3 transforming encoding and decoding matrices of $GF(2^n)$, the Galois
4 Field of 2^n elements for n greater than one, and
5 encoding data and correcting erasure errors using only exclusive
6 OR operations on words.

1 Claim 5. (Original)The computer implemented encoding and correcting
2 method recited in claim 4, wherein a (3, 3) code of distance four is used.

1 Claim 6. (Original)A computer implemented method for encoding and
2 correcting four or more erasure errors in data whose locations are known,
3 comprising the steps of:
4 converting a code over a finite field of characteristic two into a
5 code whose encoding and correcting algorithms involve only exclusive OR
6 (XOR) operations of words;
7 reading data from main volatile memory and encoding the data
8 using only XOR operations to generate a correcting code;
9 storing data and correcting code in an auxiliary array of non-
10 volatile storage devices;
11 reading the data from the auxiliary array of non-volatile storage
12 devices; and
13 reconstructing erasure errors in the data read from the auxiliary
14 array of non-volatile storage devices using only XOR operations to
15 generate reconstructed data.

1 Claim 7. (Original)The computer implemented method recited in claim 6,
2 wherein the code whose encoding and correcting algorithms involve only
3 XOR operations of words is a (3, 3) code of distance four.

1 Claim 8. (Original)The computer implemented method recited in claim 7,
2 wherein the code whose encoding and correcting algorithms involve only
3 XOR operations of words is based on a code of six symbols, $x_0, x_1, x_2, x_3,$
4 $x_4,$ and $x_5,$ each of which is an element of GF(4), the Galois Field of four
5 elements, and where x_0, x_1 and x_2 are information symbols and x_3, x_4 and x_5
6 are check symbols, the check symbols being defined by:

7
$$\begin{bmatrix} x_3 \\ x_4 \\ x_5 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix} \begin{bmatrix} x_0 \\ x_1 \\ x_2 \end{bmatrix}, \text{ that is } \underline{X}_C = A\underline{X}_I,$$

8 where a is an element of $\text{GF}(4)$ which satisfies the equation $1+a+a^2=0$.

1 Claim 9. (Original)The computer implemented method recited in claim 8,
2 wherein by substitution $\underline{X}_C = A\underline{X}_1$ becomes $\underline{W}_C = r(A)\underline{W}_1$, where \underline{W}_C is
3 a correction word and \underline{W}_1 is a data word to be reconstructed.

1 Claim 10. (Original)The computer implemented method recited in claim 9,
2 wherein, given a linear code over $\text{GF}(2^n)$, the Galois Field of 2^n elements,
3 which can correct up to e erasure errors, to a code which can correct up to
4 e erasures in words, and whose encoding and correcting can be performed
5 by XORing words, the method comprises the steps of:

6 encoding the linear code in the form $\underline{X}_C = A\underline{X}_1$, and each of the

7 corrections is also of the form $x_i = B_i \underline{X}$, where A and the B_i s are matrices
8 over $\text{GF}(2^n)$;

9 choosing a representation, r , of $\text{GF}(2^n)$, which representation
10 assigns an $n \times n$ matrix, $r(a)$, for every element a in $\text{GF}(2^n)$, whose elements
11 are in $\text{GF}(2)$, i.e., are "0" or "1";

12 obtaining the decoder of converted code by substituting the matrix
13 $r(a)$ for every element a of A , to obtain the matrix A , and substituting w_i for
14 x_i in \underline{X}_1 and in \underline{X}_C , where $w_i = (w_{i,0}, w_{i,1}, \dots, w_{i,n-1})'$ to obtain \underline{W}_1 and \underline{W}_C , the
15 encoder of the code being $\underline{W}_C = r(A)\underline{W}_1$; and

16 substituting $r(a)$ for every element a of B_i to obtain $r(B_i)$ and
17 substituting w_j for every element x_j of \underline{X} to obtain \underline{W} to recover x_i by using
18 $w_i = r(B_i)\underline{W}$.

1 Claim 11. (Original)A computer system for correcting four or more erasure
2 errors whose locations are known, comprising:

3 a main volatile memory and an auxiliary array of non-volatile
4 storage devices connected for transferring data therebetween;

5 an encoding means for converting a code over a finite field of
6 characteristic two into a code whose encoding and correcting algorithms

7 involve only exclusive OR (XOR) operations of words, data read from said
8 main volatile memory being encoded by said encoding means using only
9 XOR operations to generate a correcting code and stored with the
10 correcting code in said auxiliary array of non-volatile storage devices; and
11 data reconstructing means which, when data is read from the
12 auxiliary array of non-volatile storage devices, reconstructs erasure errors
13 in the data read from the auxiliary array of non-volatile storage devices
14 using only XOR operations to generate reconstructed data.

1 Claim 12. (Original)The computer system recited in claim 11, wherein the
2 code whose encoding and correcting algorithms involve only XOR
3 operations of words is a (3, 3) code of distance four.